

Search for gravitational wave bursts by simultaneous Doppler tracking of three interplanetary spacecraft

Luciano Iess

Dipartimento Aerospaziale
Università di Roma "La Sapienza" (Italy)

John W. Armstrong
Jet Propulsion Laboratory, Pasadena (USA)

Bruno Bertotti
Dipartimento di Fisica Nucleare e Teorica
Università di Pavia (Italy)

Hugo D. Wahlquist and Frank B. Estabrook
Jet Propulsion Laboratory, Pasadena (USA)

In the spring 1993 the three interplanetary spacecraft *Galileo*, *Mars Observer* and *Ulysses* have been simultaneously tracked for 20 days in the first coincidence experiment aiming to detect low frequency gravitational waves in the band $(5 \times 10^{-4} - 5 \times 10^{-2} \text{ Hz})$. We describe the methodology and the results of a search for waveforms localized in time, such as gravitational wave bursts produced by the formation or coalescence of massive black holes. Although the sensitivity of current Doppler experiments (a few parts in 10^{-14}) severely limits the range of sight and makes the detection of such events quite unlikely, the analysis of the data presents problems that will be encountered in many future, high sensitivity experiments in the low frequency band. The approach is based on the theory of matched filters and maximum likelihood detection, applied to non-stationary time series in the presence of time-varying instrumental responses. Thanks to the slow change in the orientation and size of the detectors, the algorithm can be built in the frequency domain, a feature that makes it remarkably efficient.

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